Na Young Han

Science

Block H

Investigation into Matter

**Commercial Chemiluminescent Chemical Reaction With Light Stick**

**The Plan**:

We are trying to observe the difference in illumination between room temperature, warm and frozen light sticks. We wanted to do this because we found out that there are a lot of experiments to do with light sticks and that it is something that not a lot of students tried to observe. The method we used was not complicated. It was something that everyone could try at home. We simply used freezer and heater to change the temperature of the light sticks. Our experiment was base on this question:

Does temperature of the surroundings of the light stick effect the glow?

**The Results**:

Qualitative data/observations:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Temperature (Celsius) | Illuminatiion (LUX) | Highest Point of Illumination (LUX) | Lowest Point of Illumination (LUX) |
| Room Temperature | 23.7 | 66 | 116.1 | 20.1 |
| Warm | 31.2 | 235.8 | 340.7 | 114.7 |
| Frozen | -17 | 7.9 | 8.3 | 0.2 |

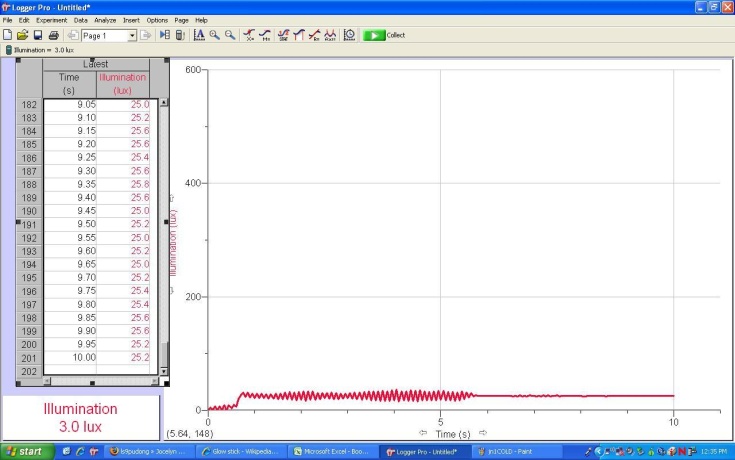
Before the experiment, Jocelyn and I predicted that the light stick in the warm water will have higher illumination and will glow more than the frozen one. Therefore we compared two light sticks (one frozen and one in warm water) in the dark room and we could tell a huge difference in glowing. As we have predicted, the light stick in the warm water glowed more than the frozen light stick.

As it is shown on the picture, it is obvious that the light stick in the warm water is brighter than the frozen light stick.

Quantitative data/observation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
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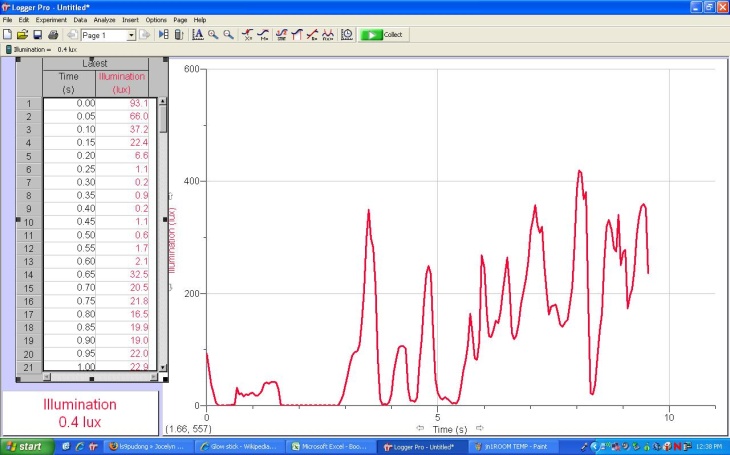
**Figures**:

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This is a picture when we used the Vernier LoggerPro

program to record the illumination of the light stick in

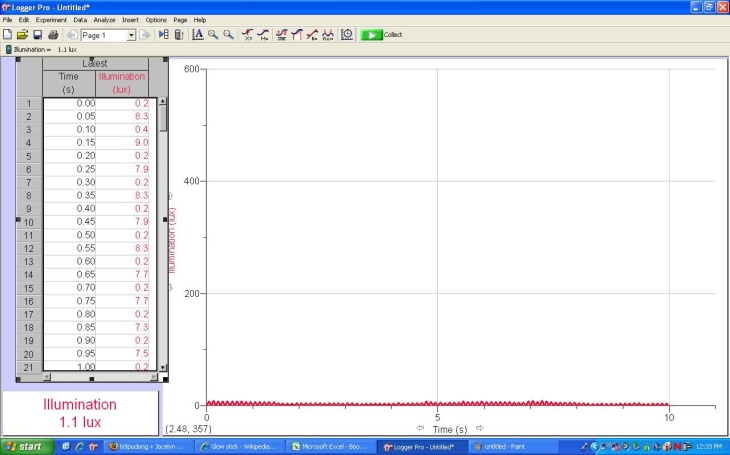
room temperature.



This is a picture when we used the Vernier LoggerPro

program to record the illumination of the light stick in

a warm water.



This is a picture when we used the Vernier LoggerPro

program to record the illumination of the frozen light stick.

**What you learned about science:**

**What scientific models/concepts/ideas from the textbook (or elsewhere) connect to your investigation? How have you improved your understanding of the atomic theory of matter?**

From <http://chemistry.about.com/od/howthingsworkfaqs/a/howlightsticks.htm>:

***A Chemical Reaction Releases Energy***

*There are three components of a lightstick. There need to be two chemicals that interact to release energy and also a fluorescent dye to accept this energy and convert it into light. Although there is more than one recipe for a lightstick, a common commercial lightstick uses a solution of hydrogen peroxide that is kept separate from a solution of a phenyl oxalate ester together with a fluorescent dye. The color of the fluorescent dye is what determines the resulting color of the lightstick when the chemical solutions are mixed. The basic premise of the reaction is that the reaction between the two chemicals releases enough energy to excite the electrons in the fluorescent dye. This causes the electrons to jump to a higher energy level and then fall back down and release light.*

*Specifically, the chemical reaction works like this: The hydrogen peroxide oxidizes the phenyl oxalate ester, to form phenol and an unstable peroxyacid ester. The unstable peroxyacid ester decomposes, resulting in phenol and a cyclic peroxy compound. The cyclic peroxy compound decomposes to carbon dioxide. This decomposition reaction releases the energy that excites the dye.*

As we can see above, the light sticks that we used for our experiment are by a chemical reaction. The chemical compounds in the light stick are hydrogen peroxide and phenyl oxalate ester. The hydrogen peroxide reacts with phenyl oxalate ester, and creates phenol and peroxyacid ester. Later the unstable peroxyacid ester decomposes into cyclic peroxy and this in the end decomposes into carbon dioxide. This chemical compounds create the chemical reaction, releasing energy to glow the light stick. This connects to our investigation because we need to crack the inside glass to observe our experiment, and by having the knowledge of how light stick works, helps the understanding of our experiment.

Throughout this investigation, now I have better understanding of the atomic theory of matter. I have learned more clearly that the quantities of the atoms are found in different states (normal temperature, warm temperature and frozen or low temperature). Now I have a clear picture in my head that the atoms move faster when the temperature rises, activating the dye in the light stick.

**What did you learn about actually doing your own experimental work? What will you do differently next time?**

By actually doing my own experimental work, I have learned that having materials ready for the experiment and planning are very important. When we first started our experiment, we had trouble getting our most important material, the light sticks. Therefore we used almost a week of time, just trying other experiments. This shortened our time in exploring more and finding out more deeply about light sticks. Also I noticed that planning is very important because since we have limited period of time to finish the experiment, if we don’t organize and finish the things that need to be done at that day, we will have hard time to conclude in the end.

If I have chance to do differently next time, as soon as I am done picking my experiment, I would write my plans to finish the experiment on a piece of paper. Also I would gather the materials needed for the experiment. Since now I noticed that consuming the time wisely and actually working as we planned is very important, I would try to make better experiment the next time.